tive to minutes instead of seconds, now becomes $K = 26AUn_0e/C$. For if the velocity of the ions produced by phosphorus is like that of other gaseous ions, U is of the order (say) of 1 cm./sec (Rutherford, Townsend, Chattock) and e of the order of 7×10^{-10} electrostatic units or 2.4×10^{-19} coulombs. The ratio of areas in my condenser was .35, the area $A = 132$ cm^2., the capacity C about 90 cm. or 10^{-10} farads. Finally the observed value of K as used in computing the above curve was $K = .634$. Thus the initial saturation $n_0 = .634 \times 10^{-10}/26 \times 132 \times 1 \times 2.4 \times 10^{-19} = 8 \times 10^4$ nearly. Hence if all the ions which reach and are absorbed by the condenser plates actually convey electric charge, less than $n_0 = 10$ ions per cubic centimeter occur in the saturated emanation contiguous to the surface of the phosphorus grid.

If now, instead of $U = 1$ cm./sec. for the field of a volt per centimeter, the absorption velocity $k = .3$ cm./sec. found in the absence of an electric field (*Am. Journ.*, March), were taken, the number n_0 would be about 3 times larger; in such a case a special mechanism of electrolysis, as I endeavored to sketch it elsewhere, is in question. What I wish chiefly to point out, however, is that the order of the velocities U and k, obtained from such widely different experiments, is about the same. Indeed if one supposes that but 1/3 of all the ions travel in a given cardinal direction, $3k$ will replace k in the above estimates, and the close proximity of $3k$ and U is even more striking.

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SCIENTIFIC BOOKS.

Report of the U. S. Commissioner of Patents to Congress for the year ending December 31, 1900. Washington, Government Printing Office. 8vo. 1901. Pp. 19.

Among the many causes which have conspired to give the United States its present leading position in the industrial world, it may be doubted whether any single influence has been more potent than that liberal system of patent law which was established in the days of Washington and Hamilton, and which has been constantly under revision, usually and until lately with improvement, throughout the century. That defect which permits the inventor to secure a patent upon the simple presentation of a written claim, with a drawing or a diagram, and without any real work in successful reduction of the scheme to practise, and that which allows the inventor to secure indefinite retention of his legal claim—by the equally simple expedient of so wording his claims that the examiner will be sure to object, taking two years to frame another objectional claim, repeating this process, until the time is ripe for gathering in a profit—will be remedied whenever the committees of Congress choose. The few defects in the existing system are capable of instant remedy and its excellent features far outweigh its faults. That the Congress, the Commissioner, the public and especially the patent attorneys permit defects to remain is unfortunate; but it remains nevertheless the fact that we have the best system of patent-law yet produced and that it has done much and is still doing much to stimulate invention, to promote the efficiency of manufactures and to give prosperity to the country and to its average citizen. No more important duty lies with the legislative branch of the Government than that of sustaining and perfecting this code.

The Commissioner reports annually to the Congress. In the report before us he states the total receipts for the year 1900 at $1,350,828.53, the expenditures $1,260,019.62 and the profits for the year as the balance, $90,808.91.

The Patent Office has always made a profit on its business with the usually poor nventor, and this extortion of money from the greatest benefactor which this country knows in industrial fields has permitted the accumulation of an enormous sum, now reported by the Commissioner as $5,177,458.55 in the United States Treasury, standing at that figure on the books of the Treasurer to-day. In other words, the poor inventor has contributed not only thousands of millions to the wealth of the nation,

and placed the United States in the forefront of nations; but he has been compelled to spend practically all that he has received, in the average case, in the introduction of his invention —for the average inventor lives and dies poor, spending every dollar he can earn or borrow in promotion of his ideas and inventions—and he has, meantime, contributed over five millions of dollars to the treasury of the wealthiest nation on earth while giving that nation's inconceivable advantage and position.*

It would seem that the inventor may well claim that he is treated with unconscionable inequity and ingratitude; but the depth of that inequity and ingratitude is not yet sounded. He has deposited in the United States Treasury, out of a painfully-earned pittance, in the course of a century, in the small contributions made by thousands of patentees, $5,000,000; which sum is definitely pledged by the nation to the purposes of the Patent Office and of the inventor for whose benefit it is in part established. Meantime, the Patent Office has been for years painfully crowded, its work seriously impeded and its employees have suffered, as well as the inventor and the industries of the country, through lack of proper provision for its work and of suitable space for its collections, papers and models, and its library, all of which are in constant danger from fire. Other divisions of the Department of the Interior have been for years past squatting in its territory and occupying valuable and needed space, belonging to the Patent Office and in its own building, while five millions of dollars belonging to it and the inventor are hoarded in the United States Treasury with its hundreds of millions surplus, and its use withheld either for constructing a new and suitable fire proof building —the proper course—or for relieving the existing embarrassment in other ways. Truly 'Republics are ungrateful'!

During the year 1900, over forty thousand patents were applied for and nearly six thousands caveats, trade-marks and designs. Twenty-six thousand patents were issued and twenty-one thousand expired. New York heads the list with 3,788 patents and Pennsylvania and Illinois follow with 2,564 and 2,439; but Connecticut leads in inventiveness; securing one patent to every 1,203 inhabitants; although the District of Columbia is reported to have one to each 1,110. The latter is of course not precisely comparable with the States; the patents being often taken out by immigrants, coming to the capital for the purpose, or by residents uniting with the inventor in application for the patent. About one in 1,500 New Englanders takes out a patent each year. The average for the country is about one patent in the year for each four thousand inhabitants. The 'Yankee' is about twenty times as inventive as the South Carolinian. Women have about one patent in each 1,000. The number of patents issued has of late years been nearly stationary at about 22,000; growth having apparently practically ceased about fifteen years ago.

Inventors complain that the law and the administration, and especially the courts, have recently often been inclined to bear hardly upon the man who provides the people with their main instrument of prosperity. Certain States are well known among patentees as dangerous, through their adverse court-decisions, and the United States District Courts and even the Supreme Court of the United States are sometimes thought too indifferent to the rights of the inventor and of the people in this direction. It is, however, hardly possible for a court to invariably exhibit the knowledge or the judgment of the expert in the field of mechanics, and the famous decision of the latter court, when it was decided in the great Sickels-Corliss case that a latch is not a catch and that a dash-pot and another dash-pot are not equivalent, must be expected to be occasionally paralleled. Something should be done, however, to restore to the inventor that consideration which was formerly his and which has of late been in some degree lost to him, in part perhaps, through familiarity with his work and through the very extent and universality of his beneficence.

As to the standing wrong—refusal to prevent

* This reminds one of the action of a Legislature of the State of New York which compelled Ezra Cornell to pay $25,000 for the privilege of endowing the Land-Grant College of that State with $500,000 and 200 acres of land to be succeeded later by millions of dollars from Cornell, Sage, Sibley, White and others.

the use of his own funds for the construction of a suitable government building for his benefit, in which fire-proof construction shall insure the safety of invaluable records and where ample space and every convenience shall insure prompt attention to his business—the senior senator from Virginia has recently admirably stated the case:

"Other nations have surpassed us in literature and the fine arts, but in inventive and useful arts the United States is far transcendent. The Patent Office, established by Thomas Jefferson and protecting for a brief period the only constitutional monopoly, the right to the exclusive enjoyment of one's original ideas, is the crown of American intellectual supremacy over the material world, even as the Constitution of the United States is the crown of political architecture and the Union itself the crowning glory of our people.

"As Francis Bacon says, 'The sciences dwell sociably together,' and we should put on Capitol Hill, facing the Senate Hall, as a companion piece to the exquisite Library building now facing the Hall of Representatives, another building of like architecture. And the American capitol of letters should have by its side the American capitol of inventive art, both facing the Capitol of the people, where their sovereignty has its highest exemplification. In that hall should be displayed the evolutions of inventions, with every invention indicated by its model, inclusive of the last improvement. It would be the greatest college of applied science that the world has ever seen; a monument to and a stimulus to invention, and leading by gradations to those truths of science which hover over the threshold of the age, 'waiting to be caught.'"

R. H. THURSTON.

Photographic Optics. By OTTO LUMMER, Professor, Assistant in the Reichsanstalt, Berlin; translated by Professor S. P. THOMPSON, London, Macmillan & Co.

A very complete and concise treatment of the theory of the modern photographic objective, with a full exposition of von Seidel's theory of aberration. The subject as a whole is rather deep for the general reader, though portions of the book cannot but help interest any who desire to know more about the various modern objectives; though they may not be able to penetrate the mysteries of the five different kinds of spherical aberration, and two chromatic aberrations which are taken into account in the computation of the complicated optical systems in use at the present time, they will find much of interest. A perusal of the book will at least give the photographer a respect for, and appreciation of his instrument far greater than can be had by the inspection of a few negatives and a glance at the optician's bill. A photographer should at least know as much about his lenses as an engineer knows about his engine, and yet how few can tell why the stop is placed in front of the lens-system in some cases and between the lenses in others, and to how many is a Zeiss 'Planar' anything more than a lot of pieces of glass stuck together and mounted in a brass tube. To the optician the book will be invaluable, it being practically the only work on the subject extant. R. W.

Geometrical Optics. By R. A. HERMAN, Fellow of Trinity College, Cambridge. Published at Cambridge by the University Press.

This book covers about the same ground as Heath's well-known work, which it resembles in some respects. The author has adopted a geometrical method instead of the usual analytical method in his treatment of refraction by coaxial surfaces and aberration, and makes use of the reduced path rather than the characteristic function in discussing Maxwell's theorems.

R. W.

DR. GRAY'S FAMILIAR TALKS ON SCIENCE.

A SERIES of little books, entitled 'Nature's Miracles or Familiar Talks on Science' (Fords, Howard and Hurlbut), has been published by Dr. Elisha Gray, and the third volume on 'Electricity and Magnetism' appeared shortly before his death, which occurred in January of the present year. Dr. Gray was unquestionably one of the prominent inventors who contributed his share to the very remarkable progress of electrical science and its application during the past thirty years. The claim often made for him that he was the inventor of the telephone is not justified by the